Accelerator Department
BROOKHAVEN NATIONAL LABORATORY
Associated Universities, Inc.
Upton, L.I., N.Y.

AGS DIVISION TECHNICAL NOTE

No. 5

Th. Sluyters
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STATUS REPORT (2) CONCERNING HIGH GRADIENT PREINJECTOR AND 50 MEV FAST EMITTANCE DEVICE

Ion Source

A duoplasmatron rig with PIG source cartridge has been tried out in the present preinjector with a four element focusing system (see Fig. 1). Only 15 mA could be accelerated up to 750 keV; besides the fact that the source was not properly working, "focus 2" voltage was limited by outer column breakdowns; so we guess that this electrode and "focus 1" had nearly equal voltage, destroying the focusing effect of the system.

Also a modified duoplasmatron source with freon cooling has been tried out using the standard grid focusing system; the extraction geometry is shown in Fig. 2. Without the extraction voltage properly working, the output current after the column was 50 mA; so we can expect a larger current next time.

Experiments with this arrangement in the preinjector will be continued during the October shutdown. Our aim is to replace the present PIG source for the duoplasmatron as soon as possible.

Pertinent parameters of the source have been measured on the test facility viz.,

a) the output current with small expansion cup as a function of extraction voltage for optimum arc and magnet current (see Fig. 3). An interesting feature in these measurements was the lower current output figures with negative pulsed extraction compared with dc extraction, the cause of this phenomena was found in the voltage drop during the pulsed part of extraction voltage due to loading of the power supply; the output current was very sensitive on the magnet value.

b) the magnetic field in front of and behind the anode (see Fig. 4 and Fig. 5).

An experiment is under way for a chopped 1 Mc pulsed beam from the source by means of pulsing an insulated grid downstream from the anode.

Improvements were made in the structure of the cathode and in the hydrogen leak construction, etc.

Modifications of the experimental ion source facility continue; the diffusion pump is installed; the adoption of an operational source with large cup and extraction electrode to the present rigging is in the drawing office. We expect this facility again in operation during November.

Short Accelerating Column

General - H.V. experiments will be made within a concrete enclosure of the 905A Building of the Cosmotron. A crane facility will be installed.

Three section H.V. column test

High voltage tests of a three section part of the short column without inner electrodes have been made up to 250 kV without clear indication of internal breakdowns during two weeks continuous running.

The skirts are ordered and they will be delivered in January, 1966. The consequence of this delay is that tests of the whole assembly can be carried out probably only up to 600 kV and full energy experiments not before February, 1966.

Column resistances

A series of measurements have been made with different fillers in the resin of small resistor blocs to improve thermal conductivity (see AGS Tech Note No. 4).

Figure 6 shows the temperature rise of some test blocs as a function of gradient; the electrical properties of the blocs were roughly identical.

A H.V. test of a "banana" [redacted] filled with BN_3 as in test bloc 2 showed a breakdown voltage higher than 125 kV in SF_6. "Bananas" with BN_3 filler are now in series production.

Short column assembling

All parts of the short column except the skirts and the bananas were delivered. However, inspection of the electrode holders, connectors, spinnings and spark gaps showed many shortcomings; nearly all parts were returned, which has caused an important delay in our program. There are five joints made.

Dome assembling

The parts supporting the dome, the capacitors, the belts, the dome itself, etc. are delivered. This will be assembled before the end of October. Source electronics can be installed during November.

High Voltage power supply

The H.V. limitation of the RDI power supply is not checked, due to a sudden stop of all H.V. tests in the experimental hall (transients on the power lines damaged delicate experimental equipment).

Power will be installed in the 905A Building before the end of September. There seems to be some indication that the limitation of this supply will be in the H.V. bushing. A modified bushing is under consideration. If this includes much mechanical construction with as much experimental work involved to get it running, than we shall decide to buy an additional 150 kV power supply and construct an adequate bushing in the dome.

G. Cottingham pointed out that in the test facility no provision is made for a protective resistor.

Neither in our present preinjector nor in the one of CERN such a resistor is included; this is mainly due to the "safe" construction of the "long" column (large inner diameter, low gradient, air spark gaps) as well as to reduce the voltage drop during the beam pulse to a minimum.

In our short column test facility, breakdowns can be expected between the titanium electrodes triggered by collisions of the primary beam (small inner diameter and high gradients). In both cases, (with and without protective resistance) the electrodes will be damaged;* however, the probability of successive sparks can be reduced by including such a resistor apart from the fact of reducing metal vapors by local heating that may deposit on insulators (lower peak current with series resistor). Damage to the SF_6 filled outer region of the column is another possibility of damage (metal vapors by local heating and perhaps shock wave damage (AGSCD Tech Note 12).

The accessibility of the column is another point of consideration.

A relatively simple solution has been found to protect column and capacitors in the present layout; this solution can also be applied to the present preinjector (see Fig. 7). The absolute total value of the series resistance is 8k Ω (allowing a minimum voltage drop of 4 kV for .5A beam current); the "bleeding" resistances (300 MΩ each) across the capacitors provide an equal repartition of the voltage across the capacitors.

Transport system column - linac

The solenoid will be in the workshop this week and a simple emittance device (photographic method) is nearly designed.

* UCRL 9487

The design of a fast emittance device for the preinjector is going on and Bob Lockey will prepare the electronic equipment.

Calculations on the beam transport system has been stopped for some time. The emittance after the solenoid is difficult to predict; it makes more sense to postpone these calculations until after a measurement with the short column.

50 MEV FAST EMITTANCE DEVICE

The mechanical part of the system is all drawn. During the shutdown, we shall install the mechanical equipment and quadrupoles except the emittance box itself. The magnet power supplies as well as the cabling for slits, quartz plates etc. will be installed.

The basic electronics for the emittance detector (with which it is possible to measure the total emittance) is finished and tests with magnets and simulating a beam signal look very promising.

Breakdown in one coil of the analyzer has occurred, (there are 2 x 2 coils in each magnet); we prepare a second improved and spare analyzer with 1.5-in. inner bore (clearance 3.2 cm.) and 5-in. long.

cc: A. Soukas
W. Schneider
R. Damm
G. Glittenberg
R. Lockey
A. van Steenbergen
A. Otis
H. Wroe
R. Larson
V. Racaniello
R. Lane
J. Keane
R. Amari
V. Kovarik

BROOKHAVEN NATIONAL LABORATORY

BY ______ DATE ______

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SUBJECT ______

DEPT. OR PROJECT ______

SHEET NO. ______ OF ______

JOB NO. ______

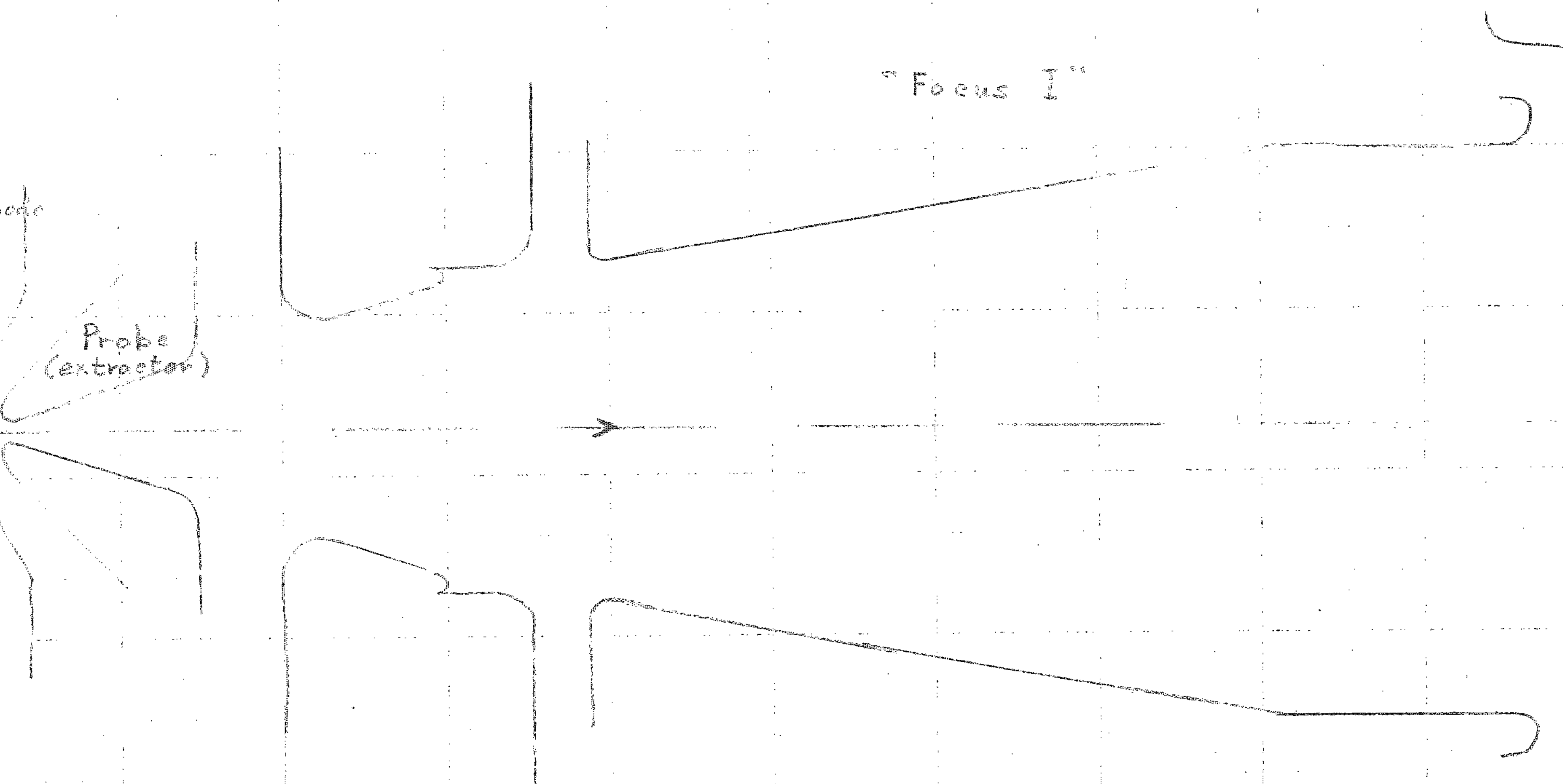

Fig. 1

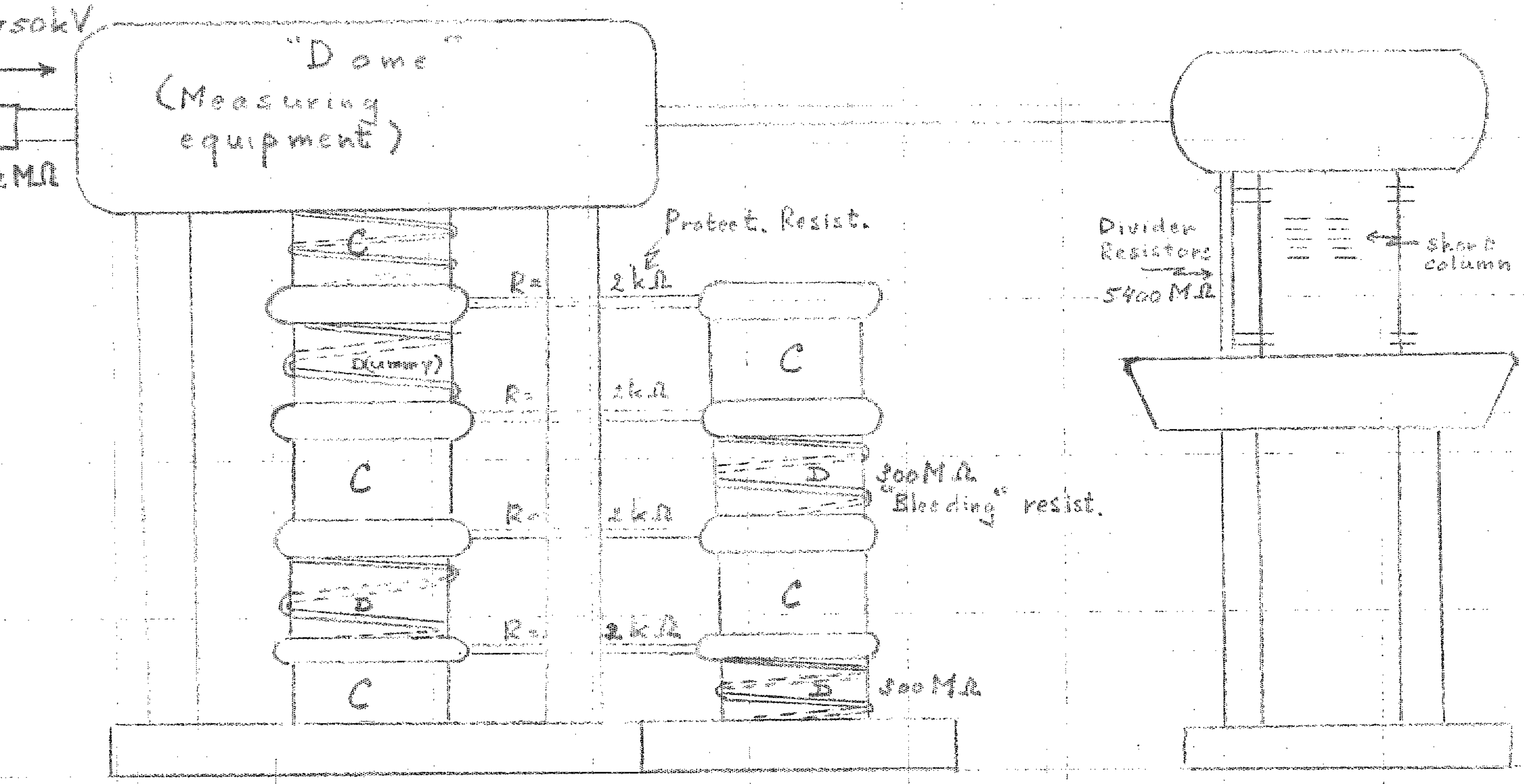
50kV
MΩ
"Dome"
(Measuring equipment)
Protect. Resist.
R= 2kΩ
R= 2kΩ
R= 2kΩ
R= 2kΩ
C
D(ummy)
C
D
C
C
C
D
500 MΩ
"Bleeding" resist.
C
D
500 MΩ
Divider Resistors
5400 MΩ
short column

Fig. 7